REPORT ON IRRIGATION

IN THE

ALWAR STATE,

WITH

NOTE BY THE CONSULTING ENGINEER FOR IRRIGATION IN RAJPUTANA.

1903.

AJMER:
PRINTED AT THE RAJPUTANA MISSION PRESS.

1903.

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REPORT ON IRRIGATION IN THE ALWAR STATE.

1. **General Description.***—The area of the Alwar State is about 3,024 square miles, the greatest length from north to south is about 70 miles, and average width about 45. Ridges of hills, for the most part parallel, and lying generally from north to south, are a feature observable throughout the whole State.

To the east and north there are a few ranges, low, narrow, short or often broken, and usually far apart, in single or at most double lines. The country to the north and east is generally open.

To the north and west of the State the soil is generally very light, but, except in parts on the western border, it does not form drift sand-heaps like those of Shekhawati. To the east there is much rich land, but where water does not lie the soil is usually light. To the south the soil is generally good.

The hills are usually rocky, precipitous and difficult to cross. Sometimes they form a high tableland, where grass grows. The highest points are between 1,900 and 2,400 feet above sea level. With the exception of the gneiss, the whole belong to one series of rocks known as the Aravalli series.

2. **Population.**—According to the Census of 1901 is 824,487. About $\frac{1}{7}$th are Musalmans.

3. About 55 per cent. of the State is cultivated; of this area about 23 per cent. is irrigated, and 5 per cent bears two crops a year.

The average yield of unirrigated land varies from 1 to 5 maunds per Raj bigha ($\frac{2}{5}$ths of an acre) according to soil, irrigated barley from 4 to 14 maunds the bigha.

In well and land, rent-rates vary from Rs. 5 an acre for sandy, ill-watered land, such as is met with mostly in the north, to Rs. 22 an acre for the rich, well-watered land of the south-west.

The most valuable canal-irrigated land is that near the city of Alwar, the water being supplied from the Siliserh storage lake. The rates paid are very high, Rs. 1-8 a watering per Raj bigha ($\frac{2}{5}$ths of an acre).

The rate charged for water from the Ruparel or Barah Nullah is Re. 1 a Settlement bigha—not half the Siliserh rate.

The water from the Deoti Lake is supplied to a few villages of Rajgarh which lie below it, only 8 annas being charged. But the villagers are rather highly assessed.

4. All the land in the State is, according to the declaration of the Durbar, theoretically State property.

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* These remarks are taken chiefly from the Gazetteer of Alwar 1878, by Major Powlett.

"Dabri," or flooded land, is chiefly in the Ramgarh and Lachmangarh tehsils. The best is in Ramgarh, supplied from the Chuhar Sidh, and the rent paid for it is as high as Rs. 9 an acre or more, occasionally. Much of it is unflooded two years out of three.

A good flood is, to the villagers within its influence, the most happy event in the year.

"Talabi" is land within a dam which is cultivated when the water is drained off.

"Katli" is land in the bed of nullahs which run dry. It is generally sandy, and not equal to the "*dabri*." When sand-bearing nullahs overflow and deposit sand, the land is at first much injured, but when grass begins to grow, if cattle are pastured upon it, it soon becomes good, light, arable ground.

5. Rivers and Streams.—The rivers and chief streams are the Sabi, the Ruparel, the Chuhar Sidh, the Lindwah, the Pertabgarh and the Ajabgarh.

The Sabi forms for 16 miles the western boundary of the Alwar State. Joined by the Sota it cuts off the north-west corner, divides a part of Bawal, which is Nabha territory, from Alwar, and flows into the Jaipur perganah of Kot-Kasim. It is by far the largest of the streams in Alwar, from which it receives many contributions, and it carries off the drainage of northern Jaipur; but its banks are high, its bed too sandy for cultivation, and, unlike the other streams, it confers no benefit on agriculture, while its floods endanger Rewari, in British territory, to the north. It cuts away good land, which sometimes leaves the brickwork of wells standing like towers in the river bed, and its alluvial deposit is scarcely fit for tillage. It dries up after the rains.

The Ruparel and Chuhar Sidh are the chief drains of the hills west and south of the Alwar city. Both are most valuable irrigation channels, and both flow in an easterly direction. The Ruparel, often known as the Barah, has almost always a flow of water, the Chuhar Sidh only after rains.

The Lindwah carries the water which flows from part of the north-eastern hills. It has in parts a broad bed. For 12 or 15 miles it runs southward, then divides, and, turning eastward, enters the British territory. It is of much value for irrigation purposes, but its flow ceases in the hot months.

From the Tahla, Ajabgarh and Pertabgarh perganahs of the State, considerable streams flow into the Jaipur State, where they join the Banganga. Of these the Pertabgarh and Ajabgarh nullahs usually flow, even in the hot weather.

In the west a nullah of some size, best known as the Narainpur, flows northwards into the Sabi, but it is dry after the rains.

The lakelets of Siliserh and Deoti are the only ones in the State.

6. **The rainfall** varies on an average from 15 to 25 inches, but the fact that between A.D. 1753 and 1868 there were no less than ten famines so serious as to form eras, before and after which events are spoken of as having occurred, show what great need there is of doing all that is possible to mitigate the miseries which they cause.

7. **Wells.**—The depth below the surface at which water is sometimes first met with is 80 feet, but usually it varies from 20 to 40 feet.

8. In anticipation of the Famine Commission, information was called for regarding Irrigation in the Alwar State, and the following report, which is deserving of record, was submitted by the State Engineer (Mr. Macdonald), accompanied by a map.

Irrigation has not been developed on many of the tanks, the people preferring to use their wells. The good the tanks do is mainly indirect, by sustaining the sub-soil water level. In many parts the configuration of the country is not suitable for storage, especially near the hills, where the steep slopes would necessitate high and expensive dams. The valleys are for the most part already occupied by wells, the revenue from which is said to be far higher than that obtainable from tanks.

Letter No. 340, dated 4th October 1901, from the State Engineer, Alwar, to the Political Agent, Alwar.

I have the honour to reply to your letters Nos. 1585 and 2144, dated 4th May and 3rd July respectively.

2. The number of Irrigation Tanks at present existing in the State, of which, it is considered mention can be made, is 102.

Of these 40 are old, but in more or less serviceable condition, and petty repairs only have been required to them from time to time.

40 are old tanks which had failed, but which have been reconstructed and enlarged.

22 are new tanks.

3. A map, in duplicate, is attached, on which the positions of the above-named tanks are shown by small circles, each containing a distinctive figure and number.

Old tanks are numbered ...	...	A to A 40
Old tanks are reconstructed	...	B to B 40
New tanks	...	C to C 22
Possible new schemes ...	...	D to D 7

On the map also the various drainage systems of the State have been defined in different colours, and numbered from 1 to 22 in large figures.

4. With regard to the data asked for, I have carefully read the instructions laid down in the enclosures to your above referred to letters, and much regret to state that I cannot comply in the form required.

As regards the old tanks I have nothing whatever to do with them, except to execute petty repairs if asked to do so.

There are no drawings or details to be found about their construction, and with them as with all other Irrigation works in the State, the management of and distribution of the water is out of my province.

I can therefore only supply such information as I have been able to procure from the revenue authorities.

5. About how the tanks are worked, or on what basis revenue is assessed, I offer no opinion, as I have nothing to do with this work, but from my observation during the past 11 years I have come to the conclusion that in this State the villagers clamour for old bunds to be repaired and new ones made, and, when their wish is gratified, will not, unless under great pressure, break up new ground as long as they have wells to work.

If the water is run off they will cultivate the beds of tanks and they will use the water run off if it flows over cultivated ground, but they trust to their wells for their means of livelihood and payment of their rent.

If without trouble they get any help from the tank so much the better. If not no matter.

It thus follows that very many of the tanks are undeveloped, and the good they do is mainly indirect by sustaining the water level of the wells.

6. I have been unable to discover any minimum either of water received or land irrigated in seasons of drought for most of the tanks, as through the past seasons, although there has been insufficient rain to mature the crops, there seems to have been, in every year, at least one abnormal fall which has virtually filled the tanks.

How the water has been used I cannot say, so I can only note results supplied to me by the Revenue officials as to the revenue realized or area cultivated.

7. Attached will be found, in four forms, such information as I have been able to procure about existing tanks and new projects which may yet be developed.

8. As Irrigation work in the Alwar State is, from an Engineering point of view, very unsatisfactory, I am giving, in the following paragraphs 9 to 16, some notes about physical and other difficulties encountered, which may, although apparently irrelevant, throw some light on the matter.

9. About one-third of the total State area is hills and hilly ground.

Here the ground slopes quickly from the hills to the streams which form in every valley, and the streams themselves have steep beds. In the valleys wherever a tolerably flat stretch of ground occurs this is almost invariably cultivated from wells.

As the revenue from ground irrigated from wells far exceeds what would be derived from that irrigated from tanks, the construction of tanks, except to fill the wells, would mean loss of revenue.

10. Where plains exist between the hills the ground is extremely friable, and the streams have deep-set and porous beds.

About this sort of ground I cannot do better than quote remarks made by Mr. Joscelyn, Superintending Engineer, Rajputana and Central India, in a note after a tour of inspection in the State.

His particular reference was to the big stream shown in drainage area No. 10.

He wrote: "We found the plains rising towards the hills, and the light loamy soil giving place to compact undulating country, deeply fissured with almost impassible ravines.

"Irrigation dams on any large scale are useless here, as the configuration of the ground is unfavourable to storage basins, and the land is so high and broken up that water could not be brought over it.

"There is cultivation in wider ravines or nullah beds which is irrigated by wells. It may be feasible and profitable to put up low bunds of dry stone across these nullahs at certain places, so as to retain the water of freshest as long as possible, and also to induce the deposits of silt to a wider extent up stream."

I may say that the latter proposal was one made by me to Mr. Joscelyn as a forlorn hope, and one, at best, of very doubtful expediency.

11. On the eastern half of the State there is a considerable extent of plain.

Here, however, irrigation work is, in places, absolutely debarred owing to water rights over the streams claimed by the neighbouring States.

For instance the water of the principal stream in the State, the Ruparel, as well as of its tributaries included in drainage area 15, is claimed by Bharatpur State, although the streams owe their origin entirely to the Alwar State.

12. On other parts of the plain where tanks can be made without question most of the available sites have been utilised.

When such tanks have been formed and assessment has been made on them, it virtually prevents the construction of other tanks on tributaries of the streams closed, as such new tanks would reduce the water supply into the old tanks and cause trouble.

In this connection, as an example, I would refer to Tanks A6 and A5 in drainage area 2.

These are fairly profitable works, and made first on the system of streams.

Tanks B11 and C8 have been subsequently, made but no further work can be constructed on these streams without harm to A6 and thus to A5.

13. Several of the first made works are on the whole fairly profitable, for the simple reason that they are situated on the few sites where a reasonable spread of water was possible with a moderate dam.

Alwar, however, is not a country for dams yielding good revenue.

The ground is too near the hills and the slope too steep.

To obtain anything like a good spread of water, dams high and expensive in proportion to the revenue accruing, have to be made, or, where the average height is moderate, the portions across the streams are high and costly, owing to the deep and porous beds of the streams and to the friable and unreliable nature of their banks.

14. Again, owing to the small spread of water obtainable and the size of the dam required to obtain it, the cost of facing dams with masonry is generally found to be prohibitive, and in most cases, if a dam has to be made at all, simple earth banks have to be relied upon where the nature of the soil really requires masonry to assist.

Very many of the bunds are thus only kept in order by constant and naturally expensive repairs, which help to nullify the projects, especially so in many places, whereas in drainage areas 2, 16 and 18, bunds have been made on the chain system, and the failure of a bund anywhere in the chain means the destruction of all lying below it.

15. Hardly a site remains where a tank can be made without either submerging well land or without well land lying between the dam and the ground which can be cultivated from the tank.

Villagers, as is possibly natural, offer strong opposition to irrigation channels being cut through their well land, even though land lying waste for want of water lies beyond it.

This opposition has considerably delayed the development of many tanks.

16. The above remarks have been made to show the difficulties in irrigation extension in the State, and also, in some way, to explain how little scope there is for future development.

They may also throw some light on the reason of the apparently nominal *direct* revenue, which perusal of the detailed notes on the various bunds will show is realized.

17. Out of the whole number of existing tanks in the State only three can be said to hold water from one year to the next.

On all other tanks it seems to be an established rule that the sluices should be opened at the commencement of the cold weather, and the water run off as fast as possible, so as to allow the tank bed to be cultivated.

What is done with the water I am not in a position to state, as the Engineering Department has nothing to do with this matter.

The three tanks, which at present hold up more water than is used are:—

(*a*) Siliserh, A13 on area 12, where a certain balance is always reserved.

(*b*) Malana, C18 on area 20, where sluice irrigation has been at present only partially developed, although this is only a question of time.

(*c*) Ajabgarh A40 on area 21, a tank without an outlet.

18. The following paragraphs 19 to 40 give a few remarks about the 22 drainage areas shown on the map.

19. *Area* 1 shows the streams rising in the range of hills forming the north-eastern boundary of the State and flowing out of it.

On the streams wherever practicable tanks have been made, with the exception of at one Site D, where with difficulty, an expensive but moderately productive project is feasible, the ground in this area is extremely friable and untrustworthy.

The average rainfall is about 23 inches.

20. *Area* 2 shows a system of a stream and its tributaries, rising in hills near the centre of the State and flowing north out of it. To works on the main stream, reference has already been made in para. 9. Inspection of the map will show the doubtful efficacy of the system of bunds on a chain, constructed elsewhere in this area.

No new site has been discovered where a tank can be made without cutting off water in part or whole from some existing work.

The average rainfall is about 23 inches.

21. *Area* 3 the water of all streams on this area is intercepted by village dhols.

The average rainfall is about 21 inches.

22. *Area* 4 is the drainage area of a considerable stream called the Hajipur or Harsoara Nullah.

There are no tanks on this area.

Here and there, at high cost giving little or no direct revenue, small works might be made to close tributary nullahs, but neither on these nor on the main stream, which has a steep slope and deep bed, does there appear to be any site where a dam showing any promise of direct profit could be constructed.

The average rainfall is about 21 inches.

23. *Area* 5 is a small strip of land lying near the Sabi River, with no streams on it and no site for a bund.

The average rainfall is about 20 inches

24. *Area* 6 is a plain of silty and sandy ground.

It has only one bund on it, where a stream running into the Sabi River has been closed at C9.

A big dam might be made across the Sabi River itself at D2, and the project was worked up some years ago, by order of Agent to the Governor-General for Rajputana.

It apparently, however, did not show sufficiently promising results.

There are no other streams on this area. Rain water falling on it is soaked up by the light soil, and where any small nullahs form they are intercepted by village dhols or ponds.

The average rainfall is about 19 inches.

25. *Area* 7 is a small strip between the hills boundary, area 6, on the west and the State border.

A few streams with quick slope cross it from the hills, but there is no practicable site on them for bunds.

The average rainfall is about 20½ inches.

26. *Area* 8 is the drainage area of a stream called the Surkh Nullah. In old days a bund was made at B12.

No other work could be constructed without interfering with this tank and reducing its value.

The average rainfall is about 20 inches.

27. *Area* 9 is the drainage area of a small stream running into the Sabi.

No site for a bund has been found on it. The slope of the ground to the stream and of the stream itself is too steep.

The average rainfall is about 20 inches.

28. *Area* 10 is the drainage area of a considerable stream called Narainpur Nullah.

Although the remarks made are equally applicable to a considerable portion of the State, a Note by the Superintending Engineer, quoted in para. 7, was especially written about this stream.

One old bund has been enlarged and reconstructed at B13 on this area, but no other site has been discovered for a tank.

The average rainfall is about 23 inches.

29. *Area* 11 is a small strip on the Jaipur border. There is one stream in it on which traces of an old broken bund are extant. Investigation shows that the site is impossible.

The average rainfall is about 26 inches.

30. *Area* 12 is the catchment of the Siliserh tank A13, the most important work in the State.

No new works can be made on this area without reducing the efficiency of this tank.

The average rainfall is about 27 inches.

31. *Area* 13 is the drainage area of the Chuhar Sidh Nullah and of its tributary the Soth Nullah.

A number of nullahs receiving the drainage of a considerable hill area collect into one stream called the Chuhar Sidh, which, after running for some distance in a wide and deep channel, discharges its water over the plain, the channel disappearing.

Three bunds near where the Soth Nullah joins the Chuhar Sidh collect and distribute the water.

Three bunds have been made on tributaries of the Chuhar Sidh, one some years ago A19, another recently by order of the Agent to the Governor-General at C10, and an insignificant one at C11; but no further works can be made without harming existing arrangements.

On the Soth Nullah and its tributaries there are 4 old works of sorts.

The average rainfall is about 24 inches.

32. *Area* 14 is the drainage area of the Lundoha or Lindwah River.

Five old-established bunds, on small tributaries exist, of which 3 have been repaired, but water rights over the river are held by villages in British territory, so no dams to hold up the water can be made.

Three works to divert flow and cause the water to submerge tracts of flat country are in existence, one on the main stream B19 and two on tributaries B20 and C12.

The average rainfall is about 22 inches.

33. *Area* 15 is the drainage area of the Ruparel, the principal stream of the State, and its tributaries.

Water rights during the rains claimed by Bharatpur State prevent this river or its tributaries being closed by bunds.

The result to the Alwar State is deplorable, as a large tract of the best country in the State is debarred from Irrigation, but until some readjustment of the treaties is made nothing can be done.

There are thus only nine bunds on this area, of which seven are old-established ones and two modern ones on minor nullahs.

The only way in which the Alwar State can attempt to benefit by the water of the Ruparel, is by temporary banks thrown across the stream to bank up the cold weather flow and divert it by canals to the plains in the neighbourhood.

The only work of this kind worth mentioning is the canal which is marked on the map near B21.

The bed of the canal at the stream is 12 feet higher than the bed of the river, and water can only be led into the canal when it has banked up to this height. For some years, owing to unfavourable rains, the cold weather flow of the river has kept diminishing, until now there is little or no flow.

The average rainfall is about 24 inches.

34. *Area* 16 shows the drainage of a considerable tract of loamy ground in the south-eastern corner of the State.

There are no well-defined streams, but numerous bunds have been made on the chain system, along the course of the general flow of the drainage.

The prosperity of the tanks depend on whether water is run from one tank to the other. If the villagers of the upper tanks are allowed to use up water on their fields, the lower lying tanks get no water but that of local rainfall.

There are no sites in this area for new tanks; in fact a great many more tanks seem to have been made than fill.

The average rainfall is about 17 inches.

35. *Area* 17 is a strip of ground with only one defined stream.

This has been intercepted by a bund at B30. All rainfall soaks into the ground or is intercepted by village dhols.

The average rainfall is about 18 inches.

36. *Area* 18 is the drainage area of the Rahera Nullah.

This stream rises in and flows for some distance in the Alwar State. It then crosses a strip of Jaipur and re-enters Alwar.

On the first portion are three bunds.

On the second portion are five bunds.

The efficiency of the latter has been lately much reduced by works in the strip of Jaipur territory, where a good deal of water has been diverted.

There are no sites left for new works.

The average rainfall is about 20 inches.

37. *Area* 19 is a small tract of ground on the State south border.

Three bunds exist, and there is a site for a fourth at D3. The average rainfall is about 25 inches.

38. *Area* 20 is the drainage area of two streams known as the Baghoni and Bhagori Nullahs, which eventually combine.

The former is closed by a new bund at C17, and there is a small old work on one of its tributaries at A39. The latter is closed by a big dam at C18, and there are four bunds on tributaries.

Below the junction of the two streams there are two bunds on tributaries.

There are no sites left on this area.

The average rainfall is about 26 inches.

39. *Area* 21 is the drainage area of the Ajabgarh Nullah.

The principal tributary is closed by a bund at C21.

It has an old bund A40, and there is also a site for a new work (recently sanctioned) at D4 higher up on the catchment.

On the main stream a fairly large work is in progress at C20, and higher up on the catchment an old bund has been reconstructed at B40.

No new works can be made above C20 without reducing its efficiency, but there are no sites, owing to steepness of the ground and to well cultivation.

Below C20 there is a small work, at present out of repair, at C22, and a big earthen dam could be made at D6 and filled by closing the river at D5 and cutting a canal across.

This project has been submitted, but as the canal would pass entirely through well land there, and the whole scheme be costly, it is yet under consideration.

The average rainfall is about 26 inches.

40. *Area* 22 is the drainage area of the Pertabgarh Nullah.

There are several old broken bunds in this area, but investigation shows them to be not worth repair. Only one site has been found for a storage tank at D7.

All through this area the ground falls exceedingly quick from the hills to the streams, and the streams have deep and steep beds, and wherever there is any flat ground it is cultivated from wells.

The average rainfall is about 26 inches.

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9. In 1901 the Alwar Council addressed the Political Agent (Lieut.-Colonel Fagan) on the subject of the Ruparel, pointing out that the arrangement proposed by Sir Henry Lawrence in 1855 has proved ineffective, from the water of the dry months not rising high enough to irrigate the land, also the loss by leakage through the earthen dam, and that Alwar is deprived of all share of the flood water, which is so much needed; they believed that some arrangement is possible, whereby the water of the stream might be distributed to each State in such proportion as may be considered fair, or a permanent dam might be put

across the stream with moveable shutters, to control the flood, and they added that since the Government of India have taken into consideration the question of Protective Irrigation Works in the Native States of Rajputana, they hoped something may be done to minimise the grievance they suffer, and to make better use of the water, much of which, it is believed, goes to waste.

10. The Agent to the Governor-General in the interests of Protective Irrigation in Alwar, considered the subject might be brought to the notice of the Irrigation Commission, which was done accordingly.

11. The Irrigation Commission, from the evidence laid before them, considered, now that each State employs an Engineer officer, it should be possible for them to devise a more scientific and efficient method of distributing the water than hitherto, so as to increase the total area of irrigation without detriment to either State, and so avoid waste of water, and in referring the matter to the Government of India, the Commission stated : "If the Government see fit to authorise the Agent to the Governor-General for Rajputana to re-open the question, it might be possible to secure the utilization of water, which under the present arrangement is believed to run to waste."

The Government of India informed the Agent to the Governor-General for Rajputana that they would view with satisfaction an arrangement which would carry out the suggestions of the Irrigation Commission.

The Irrigation Commission had referred to the utilization of surplus water, and had not taken up the main issue, *viz.*, the unequal distribution of the water, of which Alwar chiefly complained.

12. The Agent to the Governor-General then asked for information on certain points. He wished to know :—

(1) The rights of the question, apart from the point whether the water can be more equitably or advantageously distributed.

(2) Whether the orders of 1837 regarding the equal division of the water between the two States is concise and admitted.

(3) Whether Alwar is under any formal agreement not to obstruct the flood by constructing dams within its own territory.

13. In accordance with the recommendation of the Irrigation Commission in November 1902, a Consulting Engineer for Irrigation in Rajputana had been appointed by the Government of India.

All the papers were then sent to him to enquire into the most advantageous way of utilizing the water of the Ruparel, in the interests of both States.

14. With the approval of the Agent to the Governor-General for Rajputana a circular letter was addressed to the Political officers of every

State in Rajputana in February 1903, pointing out the recommendations of the Commission and the wishes of the Government of India, *viz:*—

(1) The investigation of each catchment area from its head downwards, to find out where dams can best be placed or water stored, and to ascertain all the possibilities in the way of Irrigation in each State.

(2) The inspection by the Consulting Engineer for Irrigation, of all such proposals, to give assistance or advice where required.

(3) The preparation of proper plans and estimates for a certain number of approved projects in each State. (Letter No. 329, dated 13th February 1902, para. 4, from the Secretary of the Irrigation Commission to the Secretary to the Government of India, Revenue and Agriculture).

And it was pointed out that at present it was to the first point only that it was desired to direct attention. That the investigation should be started at once by the local Engineer officers, who should take up the subject in real earnest, and for this, that no detailed surveys were necessary.

15. In consequence of this the State Engineer (Lieutenant Garrett, R.E.) submitted a memorandum, in which it was stated—

"That there are only four catchments of any size in the Alwar State from which water is not already utilized:—

(1) The Ruparel. This question is still *sub judice*, and until it is settled there is no need for careful investigation of the catchment with a view to new works.

(2) The tributary of the Sabi, which flows past Harsora, where a site exists for a dam on this nullah. Estimates and plans have been prepared and sanctioned, and work will be commenced shortly.

(3) The tributary Sabi running in Ghazi-ka-thana, and flowing past Narainpura. This has been investigated. There is only one possible site for a bund, and this has been fully surveyed. There may, however, be a difficulty in finding sufficient irrigable land below, and further surveys are in hand to settle this point.

(4) The nullah flowing south from Pertabgarh. No suitable site for a bund appears to exist, which would give a chance of paying a reasonable revenue.

There are one or two sites, which are good enough from an Engineering point of view, but the construction of the bund would involve the submission of valuable *chahi* land, and it would be almost impossible to utilise any considerable proportion of the water stored.

(5) In addition to the above, for a fairly remunerative dam across the Ajabgarh Nullah near Bhangarh, the site has been fully surveyed."

Lieut. Garrett stated he would be very glad of the Consulting Engineer's advice as regards Nos. 3 and 5.

16. When the Consulting Engineer visited Alwar in April 1903, the Political Agent brought before him the papers regarding the Ruparel for opinion.

There appeared to be so many difficulties in connection with the case, extending over so many years, that the Consulting Engineer felt some hesitation, and replied that as far as he could judge from the correspondence, Alwar does not get a fair share of the Ruparel, but that he did not consider himself justified in reopening the case, unless he received clear orders to do so. Under the circumstances the most he could do was to suggest some system of shutters to close the stream promptly instead of the earthen bund, which must always be unsatisfactory; or if it could be proved that any water went to waste, to suggest how it might be utilised.

17. On this the Agent to the Governor-General remarked that it was not clear if the Consulting Engineer meant that the decision itself was wrong, or that it had been wrongly carried out. If the decision itself is equitable, the matter, he thinks, is comparatively easy, and it only remains to give it due effect. It was then, as stated in para. 13, he desired all the papers to be sent to the Consulting Engineer, who should be asked to give his opinion as to the right way of proceeding with the case.

Accordingly the Consulting Engineer went through all the old files from the year A.D. 1833, and copied out every paper which appeared to bear on the subject, with an Epitome and Index, and submitted a Note (copy of which is attached). In accordance with the wish of the Alwar Durbar the whole of this correspondence, including a Note by the Political Agent, Alwar, and a Note by the Political Agent, Bharatpur, has been printed, and forms a volume of 118 pages, to which reference may be made by anyone who wishes to know the facts of the case. As regards these two States, Alwar and Bharatpur, the subject is an important one, and for this reason it has been alluded to here at some length.

18. The Consulting Engineer visited the sites in question with the State Engineer (Lieut. Garrett, R.E.) in October 1903. The Inspection Notes made on this occasion will be found further on.

19. With reference to Mr. Macdonald's report (letter No. 340, dated 4th October 1901), para. 8, there are a few points which it is thought deserve notice.

In para. 4 he states that the management and distribution of the water is out of his province.

It is a question for the Durbar to consider whether it would not be advisable to throw more responsibility upon the Engineer, at all events

as regards the distribution of the water from Irrigation Works he carries out; it would no doubt add to his work, but a zilladar of *abpashi* might be tried whose sole duty it would be to encourage Irrigation throughout the State, to make tours of inspection and submit reports. He might, perhaps, be placed under orders of the Engineer to help him; no one would have so great an interest in proving the success of his work as the Engineer Officer.

In para. 5 "the villagers," it is stated, "clamour for old bunds to be repaired and new ones made, and when their wish is gratified will not, unless under great pressure, break up new ground as long as they have wells to work.

"They trust to their wells for their means of livelihood and payment of their rent. It follows that very many of the tanks are undeveloped, and the good they do is mainly indirect."

This points to the advisability of a proper understanding with the villagers before money is spent; a share of the responsibility should be brought to bear upon them, through their own revenue officials beforehand. No doubt the villagers know their own interests better than anyone else, but it seems there is something wrong when they have to be pressed to make use of the water.

Some guarantee might, perhaps, be taken before expenditure is incurred, to prove that they wish for the work, and are prepared to refund the amount in a certain number of years.

In para. 8 Mr. Macdonald speaks rather despondently of Irrigation in the Alwar State, as very unsatisfactory from an Engineering point of view, owing to physical and other difficulties.

The physical difficulties of course cannot be avoided, such as hilly ground—the streams being deep set—the beds in some cases porous, and the soil friable.

It is in such cases that the genius of the Engineer must endeavour to overcome these difficulties; he knows that every drop of water he can store up is a drop to the good, and either by percolation to the wells below or by raising the sub-soil water level, will do good (see his para. 10) if it can only be done at a reasonable cost. How far this can be done in the Alwar State it is difficult to say without seeing every case, but a few bold attempts carried out in consultation with the villagers who would be benefited, will do something to prove what is possible.

In paras. 11 and 33 Mr. Macdonald alludes to the Ruparel, and the result of the orders which have been passed as regards the division of the water, as deplorable to Alwar, and that in consequence a large tract of the best country in the State is debarred from Irrigation.

From the remarks in para. 17 it will be seen that this matter has been gone into very thoroughly by the Consulting Engineer, and t it is hoped that some relief may be possible. The matter is under reference, it is believed, to the Government of India.

As regards para. 12, when tanks have been made on a stream it naturally prevents other tanks being made which would reduce the water supply to the old tanks—unless the water from one could be made use of when it was let out to replenish the lower, or unless there is any water which goes to waste, and might be stored at reasonable cost.

As regards para. 17, "out of the whole number of existing tanks in the State only three can be said to hold water from one year to the next."

There is always a danger of leakage in any tank made near a range of hills. It is often impossible to say beforehand, and it is only when the tank has been tested that one can be sure. In such cases if there are no other tanks near to guide one it is advisable not to spend much money straight off, but if possible to begin at first with a small work.

As regards para. 36 it is stated that "the efficiency of five bunds in the Alwar State has been latterly much reduced by works in the strip of Jaipur territory, where a good deal of water has been diverted." This stream has formed the subject of dispute between Alwar and Jaipur. The matter was referred to the Consulting Engineer—a copy of his Inspection Note is attached (Appendix B.)

The rules which have been submitted for the approval of the Agent to the Governor-General are, that every State or village through whose lands a stream passes, is entitled to a share of the water proportionate to the length of the course of the stream through its lands, but that no one has a right to do anything which shall obstruct or divert the free passage of the water in the main stream.

20. At the invitation of Lieut. Garrett, the State Engineer, the Consulting Engineer made a short tour with him in 1903, of which the following is a note:—

INSPECTION NOTE.

October 16th 1903.—Left Jaipur 5 A.M., by train; met Lieut. Garrett, R.E., Alwar State Engineer, at Dosa 6-54 A.M.

Rode with him to his camp at Gola-ka-bas, about 15 miles.

On the way inspected the *Birkiri Bund*, an earthen bund about 2 miles long, built across a small nullah, with a catchment area of 7·8 square miles. The greatest depth of water is 12 feet, the capacity of the tank about 38 m. c. feet, with a masonry escape at the south end, on the natural surface of the ground.

In a good year the catchment area may be expected to supply about 36 m. c. feet, nearly sufficient to fill the tank.

On the north, about half a mile distant, a nullah from Ajabgarh passes. A masonry weir has been built across this at Dherora, but was not quite completed when Lieut. Garrett inspected it before the rains. The intention of the late State Engineer was to divert the water of this nullah into the Birkiri Tank if necessary, where it would be stored for Irrigation.

Lieut. Garrett considered if the Dhcrora Weir was completed, the result would be to pour the amount of water which it was calculated this nullah would bring, *viz.*, about 163½ m. c. feet + 36 (the amount which might be received from its own catchment) = 199½ m. c. feet, into a bund which would only hold 38½ m. c. feet. He feared the Birkiri bund might be breached, as the earth of which it was made was not, he considered, to be trusted, and this was the first time it would be tested.

For these reasons he wisely left a gap 60 feet wide 8 feet in height in the masonry of the Dhcrora Weir unfinished. Between the 16th and 18th July the water poured 6 feet deep for several hours through this gap.

The water that came into Birkiri Talao from its own catchment filled the tank 10 feet deep, and breached it in two places.

If the Dhcrora Weir had been completed and this large volume of water had been diverted into the Birkiri Talao, probably great damage would have occurred.

Lieut. Garrett acted with sound judgment, and the course he adopted has undoubtedly saved much loss.

The gaps in the bund of Birkiri had been closed up, so after ordering some places in the bund to be opened out to enable us to see the state of the earth-work, we rode up the cut which had been made from the Dhcrora Weir on the right bank, and inspected the masonry weir.

It is well built. A small quantity of water was flowing through the 60 feet gap. We then rode to our camp at Gola-ka-bas.

October 16th 1903.—In the afternoon we rode to Sirsa Devi, near Bhangarh, where it is proposed to construct a dam to impound the water of the Ajabgarh nullah, where it issues from the hills.

The catchment area of the nullah above the site of the bund is about 62·5 sqr. miles of hilly and rocky country. Taking a moderate estimate of the run off as 2 inches, this will give 286½ m. c. feet as the annual discharge of the river. It will probably be often more than this.

The existing bunds above this site are—

Jaitpur	...	...	capacity	101	m. c. feet.
Kailana ...	...	...	„	18	„
Gwara Googla	...	...	„	4	„
		Total	...	123	m. c. feet.

Allowing these bunds to cut off 123 m. c.ft, it will leave 163½ m. c.ft. to be stored at Sirsa Devi.

Lieut. Garrett proposes to make the bund high enough to hold up 207 m. c. feet, and a very little more than 2 inches run off will serve to fill the bund.

If the bund fills, some 190 m. c. feet will be available for sluice irrigation, and will be sufficient to irrigate about 3,170 bighas, of $\frac{5}{8}$ acre, yielding a revenue of Rs. 6,340, or 7 per cent. on the probable cost.

If it is found that the water overflows, it will cost little to raise the bund 2 feet, and so increase the capacity by about 35 m. c. feet.

The land to be submerged is nearly all *barani* and waste. About 30 bighas or so of Chahi land, and the Dhani of Tor-ka-bas will be submerged.

There is not much suitable earth near, so the dam will have to be of masonry. There is a good site for an escape, over rock, at the east end.

From the appearance of the ground it is probable that rock will be found everywhere for the foundations, but this is a point which will require to be ascertained. If a masonry bund is adopted the foundations should be bedded on rock everywhere.

Surveys for the canals have not yet been made, but there are some square miles of good level waste and *barani* land between Bhangarh and the Jaipur border which only require water to produce fine crops.

The Plans and Estimate for this work are not ready yet, but approximately it will cost about Rs. 95,000, which includes Rs. 4,000 for canals and distributaries.

If it is found after the completion of this Sirsa Devi bund that sufficient water does not come into Birkiri Talao, it will be possible to pass off some of the water from the upper reservoir, or at a small cost to divert some of the nullahs north of Dherora, and by means of the wier to direct the water to Birkiri.

In the evening the villagers came to our tent and were eager in their request that the Sirsa Devi Bund should be made.

October 17th 1903.—We went first to Birkiri to see the three places in the earthen bund which had been opened out. The mass of earth was in small lumps, nowhere thoroughly consolidated, and only what one would expect to be the case where it had been impossible to get water to consolidate the bank when it was made.

The zemindars of the villages situated below the bund met us here, and begged that a masonry core-wall might be adopted, as they believed nothing else could be trusted, pointing to the cracks in the solid ground all round to show the nature of the soil.

We then rode, *via* Sonthal Sagar (along the bund) and on to Dosa, about 18 miles, and reached there about 11 A.M.

21. In my opinion the following is recommended :—

1. A masonry core-wall to be put in the Birkiri Bund. I quite agree with Lieut. Garrett that this bund will always be liable to be breached unless a core-wall is put in.

2. The gap in the Dherora Weir to be closed up at once, and the water which now flows over it to be diverted to Birkiri.

3. Levels be taken from the Dherora Weir right and left, so as to have, if possible and advisable, two canals, one on the right (which is already made) and another like it on the left bank. The same weir can supply both, and if the water thus diverted can be stored anywhere below, or made to fill up "nadis," or field embankments, it might do good.

4. Until the Sirsa Devi Bund is made (when all the water will be safely stored), it may be necessary to regulate the water in flood, and some simple means of controlling the supply to these canals should be devised; for instance, double masonry pillars, between which bullies or planks might be placed horizontally, and backed with earth before or during the rains, as a temporary measure; so that if the flood water is not required in the canals, it may be prevented from going down either canal, and be diverted safely over the weir.

5. Plans and Estimate to be completed and sanctioned as soon as possible for the proposed storage reservoir at Sirsa Devi.

6. The foundations to be dug and nature of soil to be ascertained at once, to enable the necessary depths to be taken in the estimate.

7. If sanctioned, efforts should be made to get the foundations put in before next rains and material collected, so that the dam may be completed before the rains of 1905, or another year's water will be lost.

October 17th.—We left Dosa at 3 P.M. by local train, and reached Alwar at 7 P.M.

October 19th.—Left Alwar at 7 A.M., drove about 8 miles, and then mounted horses and rode to Ghat, 6 miles, altogether about 14 miles.

22. At Ghat we inspected the ruins of the masonry distribution works on the Ruparel erected by Lieut. Western in 1839, and breached the next year. The river now runs on the south of these works, between them and the hill close by.

The usual earthen bund was being made, an elephant helping to consolidate the earth. The gap was closed and the water was rising, but very slowly; whether it will reach the level of the canal bed remains to be seen.

As the masonry weirs were covered with sand we ordered them to be opened out in places.

We then rode round the south side of the range of hills, which are parallel to the river on the right bank, and close to it, to the place where an attempt was once made to cut a passage through the range, with the object of taking the water off at a higher level. We crossed over the range here and returned by the river bed to our camp.

Without knowing the levels it is not possible to say whether it would be advisable, or even possible, to complete the cut through this saddle—but it looks a stupendous work, and does not seem advisable.

In the evening we inspected the excavations which had been made to open up the old weirs. Until they are cleared everywhere it is impossible to say how much of the old work is intact, but the greater portion seems to be sound and the masonry to be of excellent quality, but smoothly plastered over.

The width of the opening on the Alwar side is about 60 ft., on the left, of the Bharatpur side about 200 ft.; the guide walls between the two are about 12 ft. high. The weir itself is about 12 ft. thick, with a flooring of masonry about 12 ft. wide on the down stream side, but apparently no protection beyond.

The gap between the Alwar Weir and the hill is about 300 ft. wide. The soil is sand. The Ruparel now passes between the Alwar Weir and the hill; its banks are about 12 feet deep. The Alwar canal now takes off from the present nullah close to the hill side, where the temporary earthen bund is being made.

From a depression in the ground at the north end of the Bharatpur Weir it appears as if this weir had been breached here.

No water ever passes now over these weirs, as the floods have cut a channel about 12 ft. deep for the river, between the Alwar Weir and the hill. So the old masonry works intended originally for the distribution of the flood waters are left high and dry on the north or left bank.

The Tehsildar of Lachmangarh, Ajudya Pershad of Alwar, met us here and produced a sketch map showing the channels, by which it was hoped the water from this place would be taken, if possible, and the country would then be benefited

No water is stated to have gone down the cut during the past few years; as it did not rise high enough by the temporary earthen bund to be of any use.

October 20th 1903.—We rode down the canal for about a mile, and then across country to Naswara or Laswari, a village about 12 miles down stream, reaching our camp there at 9-15 A.M., about 14 miles.

The canal or cut from Ghat does not appear to be anything like sufficient, either in section or in slope, to pass off the share of water allotted to Alwar in 1837, and if the division of water is sanctioned by Government now, it will be necessary to have this canal entirely remodelled or the water will not have full and free passage, and the full share of water from the weir will not be received by Alwar. Whether it is possible to take the water off at this point remains to be proved. The fact that the water could not have passed off freely may have been partly the cause of the failure of the original scheme.

On reaching Laswari we examined the site of the old Hazari Bund, where formerly an earthen bund was made by Alwar across the Ruparel, completely closing the river and diverting it in a south-east course over the country.

The remains of the bund are visible on each bank, and stand about 50 ft. above the present bed of the stream, and the canal leading off on the right bank is large and clearly defined, and wide enough to carry off the whole river.

23. Having seen both places I have no hesitation in deciding in favour of Ghat, if the levels admit of the water being passed off freely. And if Government sanction the division of the waters as fixed in 1837, I would suggest the distribution should take place at Ghat: because—

(1) It is higher up and commands more country.

(2) The existing works can to a great extent be utilised.

(3) Stone is close at hand.

(4) There is a better site for taking the Alwar share.

(5) It would apparently be more difficult and expensive to make distribution works at Laswari than at Ghat.

24. What is now required is—

(1) To open out all the existing masonry work at Ghat.

(2) To have accurate plan and sections made of these and of the ground adjacent.

(3) A section to be taken from the old Alwar Weir to the hill side.

(4) A few sections of the hill side to fix the best point to connect.

(5) To close up the original Alwar Weir with masonry, and to make a similar opening on the rock at the hill side, cutting away whatever is necessary to gain the required width. The material so cut away can all be used in pitching where required.

(6) To connect the old broken masonry wall at the south end of the old Alwar Weir, with the proposed new site for the Alwar Weir, by a masonry wall carried below the present bed level of the nullah (or it may be undermined), and to protect it in front with earth and stone pitching.

(7) To back up this new bund with earth, carrying it up to perhaps 20 ft. above the level of the weir whatever that may be fixed, so that the flanks shall never be overtopped.

(8) To remodel the old canal, and to see if any better line can be adopted.

If the old site of the Alwar Weir is adopted, there will be difficulty and expense in leading the water from it across the present bed of the stream to the present canal. The water will pass along the side of the diverting wall, and it will require great precautions to prevent the scour along the side from undermining the wall or bank; besides this it would be necessary in any case to close the gap between the old weir and the hill side in order to make the water pass over the old weir; it is obviously

unnecessary to close the nullah in both places. If the new weir is made under the hill, the proposed bund will serve to divert the water to the new weir, from which it will pass at once directly down the canal.

There will be very little scouring action, though it may be advisable to pitch the left bank of the canal for a short distance, to prevent any fear of the water getting back to the river.

25. As regards the Bharatpur Weir, after this has been all opened out it will be possible to state what repairs are necessary.

In any case I would recommend a water cushion and a good wide apron of dry rubble to prevent any damage from the water cutting back, after it passes over the weir on its passage to rejoin the river.

The soil is only sand, and if the surface is not sufficiently protected, damage is sure to occur here.

A water cushion or rapid, well-protected with rubble, is absolutely necessary. Until the work has been tested and proved, plenty of dry stone should be at hand to fill up any holes, and every precaution be taken. It is this part of the work where damage may occur; if it does, it will wreck the work and rob Alwar of every drop of water. The toe of the apron is the weak point; large concrete or rubble masonry blocks, weighing several tons, should be placed in a line, close but independent of each other, blocks which would be too large to be washed away and would keep everything behind them from moving.

26. As regards remodelling of the canal, it may be found impossible to pass off the flood water, even if the weir is raised or widened; as the slope of the bed is so very little, both weirs would have of course to be kept level, and if one is widened the other would have to be widened also in the same proportion.

It seems advisable to have levels taken, north of the Bharatpur Weir, to find out if it is possible to make an earthen bund to prevent floods passing round the north or left flank, and on this will depend the height to which the weirs might be raised.

Also to see if it will be possible to take the water from the Alwar Canal eastward so as to gain the natural surface of the country sooner than it would reach it by the old canal.

There is not sufficient data at present to enable a decision to be arrived at on these points.

27. There remains another alternative, and that is to take the Alwar share of the water by bunding up the river, and cutting off the drainage area which Alwar claims, and letting all the rest go to Bharatpur.

Whether this is possible or not, and if possible, whether it is better than the distribution scheme at Ghat remains to be considered.

I have seen the Barah Ghat and Valley, and as far as I have seen, the Site at Ghat where the distribution was originally fixed appears to be the best place.

28. Having been asked to look into the subject of the proposed water-supply to the city, the Consulting Engineer on his visit to Alwar in April 1903, inspected the site of the proposed storage reservoir with Lieut. Garrett.

It is proposed to bund up a nullah, which issues from the hills about eight miles north of the city, where, if it retains water, it will be possible to store two years' supply or more. The foundations were being dug.

The bund here will be cut off water from below, and, as Lieut. Garrett has pointed out, will mean the loss of some revenue, but the Political Agent and the Council have stated that they were prepared to accept all responsibility on this point, as it was considered the urgent need of water justified the construction.

There is always a risk of a bund near hills not being perfectly water-tight, but Lieut. Garrett appears to have done all that it possible to reduce leakage to a minimum, and the object in view seems to be worth some risk.

The Consulting Engineer explained at site a few suggestions regarding the construction of the supplementary bunds on feeders higher up, which are intended merely to divert, not to store water.

If the main bund is found to hold up water satisfactorily, the question of bringing the water to the city will then be taken up; the proposal is to lead the water by gravity in a covered channel into proper reservoirs, where it would be filtered and pumped to a height sufficient to supply all parts of the town.

These details remain to be worked out.

On his second visit in October 1903 the Consulting Engineer inspected some of the most frequented wells in the city, with Lieut. Garrett and the Rev. A. P C. Jameson. Complaints were made everywhere regarding the scanty supply of water, although this is only (October) a few weeks after the rains. How far this is due to the deficient rainfall of the past few years it is difficult to say. In some of the wells the water was only a foot or so in depth, notwithstanding a large sum had been lately spent in clearing them out.

The Consulting Engineer suggested that a statement should be got from the Municipality, showing the number of wells, the depth of water in each, the amount which had been spent lately in clearing them out, and the opinion of the Sanitary Officer as to the need of a better water-supply.

29. In April 1903 the Political Agent asked the Consulting Engineer to advise regarding the Pertab bund situated above the Alwar City, where for some reason or other water does not remain. The wall of the bund has a very deep foundation; an excavation had been made 60 feet deep, but the bottom had not been reached. Some of the old inhabitants

say there is some channel down which the water escapes, and that they can hear the noise of the water flowing away, and that at a certain place about three hundred yards from the wall the water eddies just as it would if flowing down a hole.

The Consulting Engineer inspected the bund and the excavated hole. The masonry of the bund is good.

The water must find its way under it or through fissures in the rock. The uncertainty which surrounds the question makes it advisable not to spend money on any uncertain attempts.

The bed is cultivated, which is something gained. The water might, perhaps, be quickly run off if there was any place to store it, but even if it sinks into the soil it ought to benefit the wells below.

30. In the afternoon drove to Siriska, 24 miles, and stayed at the Maharaja's Shooting place, a large masonry house containing about a dozen rooms built on three sides of a hollow square open towards the east.

A capital road made by Mr. Macdonald (late State Engineer) passes by the Barah Ghat through picturesque hills, fairly well covered with jungle and small trees.

October 23*rd* 1903.—Started at 6-15 A.M. drove in a tonga to Ghazi-ka-Thana, 8 miles, and rode on from there to Rampura and Kola-ka-bas, 5 miles north-west, and back the same way, about 25 miles.

At Rampura inspected the site of a bund proposed by Lieut. Garrett. The nullah is about 20 to 25 feet deep, the soil is loam mixed with kankar. There is a small rocky hill at the east bank of the nullah, and it would be necessary to make an earthen bund on the east side to prevent the water spilling over to the east side. The escape is proposed to be at the south end of this earthen bund eastward, over the natural surface. The ground appears to be more or less cultivated. There will be a few fields submerged. The land it is proposed to irrigate lies northward round Bijehpura and appeared to be somewhat cut up by nullahs or ravines.

The irrigation ducts had not been surveyed yet, and the amount of land which would be commanded, nor the value of the *Chahi* land which would be submerged, were not stated. The plans were not complete yet, so it is impossible to give a fair opinion now, whether as an irrigation project it would pay; but there is no doubt, to store up water here or anywhere in these parts would benefit the country. People complained of the scanty supply of water in their wells, which is due, no doubt, in some measure to the deficient rainfall of recent years, and to the fact that most of the surface drainage runs off the soil and is lost to the country.

Before committing one's self to the Rampura site it is suggested the nullah should be examined higher up, to see if any better site exists for a storage reservoir.

If, for instance, a reservoir could be economically made by a dam on a line from Basi to Gwara, about six miles higher up, just below the junction of two nullahs, or elsewhere, it might be possible to irrigate part of the country north-west and north of Ghazi-ka-Thana. It needs investigation.

31. There appears to be a good deal of land lying waste north of Ghazi-ka-Thana, owing to the surface being intersected by small shallow ravines, which carry off the surface drainage, drain the soil, and by degrees cut back.

Many of these shallow ravines might be bunded up with earth, so as to form large pools, the surplus water being diverted from one depression to another over the natural surface. The water so collected, as it soaked in, would benefit the wells near; the cutting back of the soil would be, to a great extent, stopped; and the depressions would gradually fill up and form beds for *Talabi* cultivation.

The expense would be small, and if the experiment was tried in two or three places, in consultation with the revenue officials, it would soon be seen if it was worth while to do more. It is a process which natives understand, and it would form a good sort of work for famine relief.

The object is to retain the surface drainage where possible, instead of letting it run to waste and cut up the ground, as it often does now.

32. In August 1903 the Consulting Engineer for Irrigation was asked for an opinion regarding a dispute which had occurred between the States of Alwar and Jaipur, as to the waters of a stream called the Nehri on the eastern border. He personally inspected the sites and submitted a Note, copy of which is attached (Appendix B).

33. From a perusal of this Note on Irrigation in the Alwar State it will be evident that the subject has been well considered by the officials and the Durbar, and that all that is possible is being done.

Lieut. Garrett, R.E., the State Engineer, evidently takes a keen interest in the subject, and his exceptional abilities and energy are sure to succeed, and he may be trusted to do all that is possible.

(A.)

No. 656.

Note on the Ruparel Case, Alwar and Bharatpur, by Col. Sir Swinton Jacob, Consulting Engineer for Irrigation in Rajputana, June 1903.

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1. Every paper which appeared to bear upon the subject has been copied out; and to facilitate reference, an Epitome and Index have also been prepared. These papers are attached.

2 It is only after one has read all these papers, one realizes the difficulties which surround this case—difficulties which have been increased by the spirit which has so often been shown on one side or the other; difficulties experienced in arriving at the truth of the statements made, the great value attached to the possession of the water, the varying rainfall, and the interpretation put on the orders which have been given.

3. For instance, Lord Lake's Sanad and the agreement by Alwar to allow the "necessary quantity" of water to Bharatpur. See page 5.

Lieutenant Western states: "If Alwar be allowed to use what she pleases, without being allowed to throw any bund across it (the stream), Bharatpur will receive nearly the whole of the water," and if Bharatpur is to have "the necessary quantity" she will no doubt be able to use the whole of the water. Page 10.

The Secretary to the Government North-Western Provinces enunciates "the principle of securing to Alwar a fair proportion of the waters of the Ruparel for the irrigation of her lands, without depriving Bharatpur of her proper supply." Letter No 151, dated 1st Oct. 1836, to Col. Alves. Page 16.

4. The meaning of the "necessary quantity" as interpreted by Colonel Alves, Agent Governor-General, is the quantity that "will be supplied by Alwar being prevented from cutting off any part of the supply which is not required for internal cultivation, while she is allowed to use as much as the irrigation of her lands may call for." Page 12

He agrees with Mr. Blake (Assistant Agent Governor-General) that a fair division might be made, sufficient to supply the wants of Alwar without infringing upon any right of Bharatpur.

That the share to Bharatpur should consist "of all that can be spared by Alwar after her own lands are irrigated without waste, and without any unnecessary stoppage of the Ruparel and its distributaries." Page 13.

"The fair supply of water to either State ought to include a full provision for the Irrigation of the Alwar district of Govingarh, leaving any excess to pass from it uninterruptedly to the perganah of Nuggar (Bharatpur). Page 14.

Page 4. 5. That this was the intention of Lord Lake is borne out by the fact that while providing for the wants of Bharatpur "the demolition of the bund was in no respect ordered,"—and both Colonel Alves and Page 12. Mr. Blake considered "the breaking down of the Laswari Bund would be at once unneccessary and unjust."

6. The summaries of this case are to be found in—

Page 2. (1) A letter from Colonel Alves, 16th September 1835.

Page 34. (2) The printed correspondence sent up by the Agent Governor-General, Sir Lewis Pelly, under his No. 868-507, dated 21st February 1874, beginning with a letter from the Political Agent of Alwar (Captain Cadell).

Page 62. (3) A note by Mr. White, Superintending Engineer, Rajputana, 30th August 1901.

Page 67. (4) Major Impey's (Political Agent, Alwar,) letter No. 3680, dated 22nd October 1901.

(5) A precis of the case made in the office of the Secretary Public Works Department, Rajputana (April 1902), alluded to on page 76.

Page 1. 7. In 1833 Colonel Alves urges the importance of the question, and asks that it may be settled as soon as possible in a satisfactory manner. 70 years have passed and still the question arises.

Page 23. The object of the enquiry ordered by Government in 1837 was to ascertain and "to secure to both States an equal share of the waters of the Ruparel." The Government North-Western Provinces sanctions the recommendations which were made and the construction of the necessary works to secure this result.

Page 30 8. That Bharatpur accepted this arrangement is proved by the statement made in the kharita which accompanied letter No. 27 from the Political Agent, Bharatpur, to Sir Henry Lawrence, dated 29th July 1854: "All that the Bharatpur Raj wish is shortly this, that the portion of water assigned to her by the decision of 1837 be preserved to her without let or hindrance."

Page 24. 9. The Alwar Rao Raja expressed his satisfaction, as reported by Lieutenant Western in his letter, dated 14th April 1837. Of course both States trusted that the calculations made by British officers correctly represented the stipulated shares, and that each State would receive the quantity allotted.

10. It appears to me, therefore, we are on safe ground in accepting this as a basis to work from.

The arrangement was proposed by British officers, sanctioned by the Government N.-W. P., approved by both States, and the works were constructed under British supervision, in part, if not altogether.

11. If these arrangements had been properly completed there would probably have been an end of the dispute.

Under these circumstances it seems incumbent on the British Government to see that they are properly carried out, and this is what Alwar now asks for.

12. If the works constructed by Lieut. Western had been permanent, and the canals had carried off the respective shares allotted to each State, there probably would have been no further dispute; each State could have made whatever use it liked of its share of water. Page 65.

Unfortunately the distributing works were breached the next year (1840); the Laswari Bund, which Alwar had made (of earth only) and had successfully controlled the floods, had been cut through by the order of Lieut. Western; and the Oomren Bund (made by Alwar higher up) was also breached soon after.

The State of Alwar under these circumstances may be imagined.

13. Lieut. Goodwyn, R.E., who was sent to repair the weirs, shows how impossible it is for Alwar now to get a fair share of water. It is not surprising that the Rao Raja asks the reason why he does not receive his share of water, a question to which it does not appear he ever got a satisfactory reply. Page 24. Page 25.

14 Before going further it seems advisable to point out what appear to be defects in the above arrangements:—

(1) The interests of other riparian owners appear not to have been considered. The conclusion is that there was water enough and to spare.

(2) The equal division of the water ought to have taken into consideration the drainage of the whole area in question approximately, half the drainage from the hilly portion and half from the portion in the plains.

It is now found from the Government Topographical Maps that Alwar gets 77 sq. miles off the hills, while Bharatpur gets 223, and 26 sq. miles of the portion on the plains, while Bharatpur gets 256 sq. miles. Page 79.

Lieut. Western felt that there was some uncertainty in his calculations, for he says, "the velocities of these streams in the rains may be different from each other at different or at all times, and this of course would alter the values. I have taken this method as the only practicable one without a careful survey of the whole country drained by the several streams." Showing the importance he attached to a careful survey of the whole country, which has since then been made; and that he would have taken this into consideration had it been possible then to do so. Page 23.

(3) The channel from the weir is described as not having been properly dug and with insufficient slope. Lieut. Goodwyn says, "it is utterly impossible that the Rao Raja can get any water during the dry season, and certainly not more than $\frac{1}{10}$th instead of $\frac{1}{4}$th flows through it in the rains." Pages 25, 26 and 24.

15. Unless both channels had the same slope away from the weir, and there was a full and free passage for the water, the stipulated quantity could never run off. This may have been partly the cause of the weir being breached. It is not likely that this point can have escaped Lieut. Western's notice, and the inference is, that his proposals were not properly carried out.

16. Probably the chief cause of the failure of the weir was the want of a good supply of dry rubble stone, at the toe of the outer slope. There was nothing to prevent the scour which took place, and so wrecked the weir. This was a grave defect, and sufficient to account for the damage which occurred at this part.

17. We are now confronted with the following facts: all the bunds broken, Alwar getting no water, and all the floods going on to Bharatpur and the lands below.

Page 29. Colonel Sutherland, Agent Governor-General, expresses the situation thus: "There is no question but that the measures adopted by us in the last few years have reduced to almost barrenness lands heretofore fertile (letter No. 353, dated 17th March 1840, to the Secretary to the Government North-Western Provinces).

Page 26. 18. Lieut. Goodwyn, R.E., who was sent to report, estimates the cost of all the repairs, and the proper digging of the Alwar channel, at Rs. 60,000; which Alwar is expected to pay. The Rao Raja naturally
Page 26. wishes to get every drop of his share of water; not so much "in the dry season" as in the rains, which apparently had been misunderstood.

Page 26. He asks, if this great expense is incurred, will he get his full share at all seasons. Lieut. Goodwyn is unable to satisfy him on this point
Page 27. beforehand, and the Rao Raja declines to go on with the work unless the expense is shared by Bharatpur.

Bharatpur gains immensely by the bund remaining in its broken state, and naturally refuses to pay anything.

19. Alwar considers apparently that the work was done for their mutual benefit, that it was not his fault that it was breached, and fails to see why he should be called upon to bear the whole cost, especially when no guarantee can be given that if he did pay he would get his full share of water.

Page 27. He asks, if the expense is not to be shared by Bharatpur, whether he may not have his share of water from some other place, wherever the Government might fix, and where he would be put to less expense; and he would rest satisfied with their decision.

Page 27. 20. Colonel Sutherland, A.G.G., decides that as Alwar is to get the water Alwar is to pay.

The work has never been carried out, and I think it is impossible not to feel some sympathy with Alwar under the circumstances.

21. It was a great mistake on the part of Alwar not to have restored at once the distributing weir, whatever the costs. All the disputes which have since arisen and the present unsatisfactory state of matters, may, I think, be put down to this cause; and the only final solution I see is to insist upon this being done now. Mr. White, Superintending Engineer, Rajputana, agrees with me in this opinion. (See his Note, page 63). Page 63.

22. The Political Agent at Bharatpur even then seems to have felt that the question could only be settled by reconstructing the dam with its regulating sluices, and suggests that a British officer should be sent to design and carry out the masonry work in a way, at any costs, that will prevent future disagreement. Pages 29-30.

He points out that though our own regulating works could not be made to withstand the destructive effects of the floods, the Laswaree Bund (made of earth by the natives) was able to do so; and that the water sound its way by natural channels of outlets above the bund; and the expedient, if resorted to now, though with artificial in place of natural outlets, seems to promise means of affecting the object.

23. I entirely agree with him, and am of opinion that a satisfactory solution of the question was, and is now, possible on the lines indicated. Large escapes on the natural surface of the ground at one or each end, or wherever advisable, of a strong earthen dam, would have ensured the passage of the surplus water without any fear of damage.

To show the difficulty of getting at the truth and the desire of British officers to act justly, a reference may be made to the letter of the Political Agent of Bharatpur (letter No. 5, dated 2nd February 1855, to Sir Henry Lawrence, Agent to the Governor-General). In forwarding previous complaints from Bharatpur, he allows that he has been misled; from personal inspection he believes Bharatpur had gained rather than suffered; "that the real object of the complaints by Bharatpur appear to have been more to keep open the question of its rights;" that "it was Alwar rather than Bharatpur should press for the partition by the construction of permanent works for this purpose;" that "Bharatpur was merely seeking to injure its neighbour by seeking to procure the absolute prohibition of a kutcha dam," and he advises "no further mooting of the question for a permanent structure unless Alwar should press for it." This Alwar now does. Page 31. Page 32. Page do.

This is the opinion of the Bharatpur Political Agent. Alwar at this time had no Political Officer.

25. In the face of these statements it is difficult to account for the concluding para. of his letter to Sir Henry Lawrence, "that Alwar should not be allowed to begin the construction of the kutcha dam (which no doubt Alwar had made, and which would, perhaps, have interfered with the free passage of surplus water) before 10th or 15th October, and to remove it before the 15th June." Page 32.

26. Sir Henry Lawrence (15th February 1855) had no objection to the bund which had been made remaining till the 10th June, but ordered after the 10th June it must be removed altogether. A similar bund Page 32.

might be erected after the 15th October, and that no other bund save the above must be built. He appears to have had no data to guide him, and saw no other way perhaps of settling the matter.

27. Alwar had undoubtedly a right to a share of the flood waters. This was not recognised. There is nothing to show that Alwar would get the equivalent by the flow of the dry months; no searching enquiry as to the volume of water each State would receive. "The river has absolute-
Page 42. ly ceased to flow shortly after the termination of the monsoon" (*vide* Captain Cadell's note, August 1873, para 21). So that the equivalent, contemplated by this arrangement even, is not received. No consideration appears to have been given to the fact that it entailed an annual expense to carry out, nor that there would be any adequate return on the expense incurred.

28. It appears to have been a temporary expedient to remove friction; but in my opinion it was in no sense an agreement, nor was it ac-
Page 60. quiesced in by Alwar; and the fact that it has been proved by experience to have acted "unfairly to Alwar" has been the cause of the repeated appeals made by Alwar.

Page 70. 29. It is stated that all these papers of 1854-55 were not submitted to Government when the case was sent up in 1874.

30. The action of Captain Caddell also deserves notice. When he was Political Agent of the Eastern States in Rajputana in 1870, in the interests of Bharatpur, he directs the demolition of a bund erected by
Page 33. Alwar at Moorgana-ka-Ghat, in conformity with orders which had been passed by Colonel Keatinge, the Agent to the Governor-General, the previous year.

Page 36. Compare this with the strong opinions expressed in his report in 1873, when he was Political Agent of Alwar. He must have been well acquainted with both sides of the question. He considers the unequal division of water to be "a grievous wrong" to Alwar (para. 26 of his memorandum
Page 43 of August 1873). Testimony such as this carries weight, and deserves attention.

Page 33. 31. When Sir George Lawrence was Agent to the Governor-General, and an appeal was made to him, he says: "Whatever my opinion on the general question may be, I do not see that there are sufficient grounds for reopening it in this case; and considered "the litigation on this vexed question, which had for so many years involved a large amount of correspondence and taken up the time of Political Officers, was finally set at rest by the decision of Sir Henry Lawrence."

Other Agents to the Governor-General have followed this line whenever an appeal has been made, apparently attaching more weight to this order then to the agreement of 1837.

32. The continued appeals of Alwar, supported by the opinions of every Political and every Engineer officer who have studied the question since that decision, prove that the matter has not been set at rest, and these facts and opinions deserve consideration.

Colonel Marshall, R.E., Superintending Engineer, Rajputana, considers that Captain Cadell's contention was sound, and that the reply of Bharatpur was feeble and evasive, and thinks that Alwar has been unfairly treated in the past. Page 60.

33. Mr. White, Superintending Engineer, Rajputana, says: "The question at present at issue is, whether or no the construction of a permanent bund with shutters that could be laid flat on the bed during the monsoon and could be raised on the 15th October, would in any way infringe the rights of Bharatpur or do injury to the Bharatpur supply. I have no hesitation in saying that no injury of any kind would be done to Bharatpur by the construction of such a dam." Page 62.

This, however, would not give Alwar any share of the floods, to which so much value is attached. Page 26.

Mr. White adds: "It has long been known to the Alwar people that the arbitrary partition of the water of this stream, supposed to be on the half and half basis, made in 1838, has worked out in practice to the disadvantage of, and most unfairly to Alwar," and that "this state of things has come about, no doubt in the first instance, through the mistake the Alwar Durbar made in not at once restoring the distributary weir *erected in 1839*, and breached the next monsoon." Page 63.

"At present owing to the length of time necessary to make the temporary bund, Alwar does not in practice obtain any advantage from its right in the matter until nearly a month after the prescribed date." Page 62.

"There is little doubt that Alwar is suffering a grievous wrong, owing to Bharatpur getting practically the whole use of a river in which they have equal rights."

He considers that "the Settlement Operations have converted what was previously an indefinite suspicion of unfair treatment into an absolute certainty," and "annually excites in the Alwar people discontent." Page 64.

34. The Settlement Officer, Mr. O'Dwyer, who knew both States, writes: It is not surprising that Alwar is dissatisfied with an arrangement which has reduced her position from that of predominant partner first to that of equal co-sharer, and finally has left her with only an insignificant fraction of the irrigation. Page 65

35. Major Impey expresses his opinion very clearly. Lieutenant Colonel Fagan, Political Agent, Alwar, writes: "I think everyone who has any knowledge of this question is ready to admit that Alwar is not fairly treated in the matter of the distribution of the waters of Ruparel, and this being the case, every year's delay adds to the Alwar grievance." Page 67.

Letter No. 1788, dated 2nd May 1903.

36. A perusal of these papers will show, I think, the rights of the question, and that it is possible to make a more equitable distribution of the water.

(2) Also that the order of 1837 regarding the division of the water between the two States is concise, and has been admitted,

(3) That while Alwar has the right to use its allotted share of the water at all seasons, it is not permitted to cause any obstruction to the free passage of the share allotted to Bharatpur.

37. It is not a question, I think, of re-opening the case, but simply of giving effect to the original agreement, approved by both States and sanctioned by Government N.-W. P. in 1837.

Although Alwar believes the original decision was given on insufficient data, and the shares allotted by it do not give Alwar the full benefit which it might otherwise have acquired by that decision, it simply asks that that decision may be carried out in whatever way the Government may decide; instead of the subsequent ruling (by Sir Henry Lawrence) in 1855, which was never approved by Alwar, and has in its working proved so unsatisfactory and prejudicial to the interests of Alwar; and is acknowledged by all who have studied the question to be unfair.

38. I have not had an opportunity of discussing the question yet with any of the officials of Bharatpur, but hope to do so soon.

Page 73, letter from Mr. Devenish, late State Engineer, Bharatpur.

In the meantime, from enquiry I have made, I am informed that all the water from the Ruparel that enters the Bharatpur territory is used, and that none of it runs to waste; and that some two lakhs of rupees have been spent in providing subsidiary reservoirs and distributary channels.

This doubtless complicates the question, but cannot alter the terms of the original agreement.

39. I therefore suggest—

(1) That the Political Agent, Alwar, be informed that the agreement of 1837 must be adhered to; but if Alwar considers it is not getting its stipulated share of water, it is open to the Durbar to state what steps it wishes now to take to secure its proper share, and to submit its proposals without delay.

(2) When the Plans and Estimates for the arrangements proposed by Alwar are received, Bharatpur may be asked what objections, if any, it has to this arrangement.

(3) If the Agent to the Governor-General approves, a conference with the representatives, Political Officers and Engineer Officers, of both States, then be held, as soon as convenient.

(4) When all these papers have been received, and after the conference, it will be possible either to send the case up to the Government of India, with recommendations, or to issue orders and inform the Government of India accordingly.

S. S. JACOB, Col.,
Consulting Engineer for Irrigation in Rajputana.

Simla,
20th June 1903.

(B.)

Note by Col. Sir Swinton Jacob on the Nehri Case, 15th August 1903.

1. This Note is prepared in accordance with the request of the Hon'ble the A. G.-G., intimated through the Secretary P. W. D., Rajputana, dated 27th July 1903.

2. I wrote to the Political Agent, Alwar, on the 31st July asking that some official might be sent to meet me at the place on the 14th August, to point out what was the cause of complaint.

The Jaipur Durbar were also informed, and Lala Rupchand, Assistant Engineer, was deputed to accompany me.

3. We reached Hindon Road on the morning of the 14th, and were met there by the undermentioned officials on the part of Alwar:—

Pandit Baij Nath, Deputy Collector; Tehsildar Jagat Narain of Kathumar; Tehsildar Ajodhya Pershad of Lachmangarh.

It was arranged we should see the place (which is only about $\frac{3}{4}$ mile from the rest-house) at 4 P.M.

4. About 1 P.M. I sent a Munshi to see if there was now any obstruction of any kind in the Nehri. On his return he reported that he had seen 8 or 10 men, with 2 men in uniform putting some obstruction near the mouth of the sluice belonging to the Thakur of Garh (Jaipur), who, directly they saw him, ran away in the direction of Saipur (Alwar), a village close by.

5. I made him put his report in writing, and sent it to the Thanadar to make enquiry and submit his report.

6. The only conclusion, I think, one would draw from this, is that it was an attempt, on the part of interested persons, to make it appear that the Thakur of Garh (Jaipur) was diverting the stream.

No one else could have any object, certainly not the Garh people, when they knew we were coming to inspect the place; the fact of the men running away towards Saipur (Alwar) confirmed these suspicions.

7. I have mentioned this incident merely because it shows the deception so often resorted to in cases of this sort, forgetting that a strong case needs no support of this kind.

8. At 4 P.M. we went to the Nehri, which is now quite dry, and inspected the masonry sluice to the Saipur cut (about 10,450 ft. below the point where the bridge on the road to Hindon crosses it), where the water could be easily diverted at any time. The sluice is a rectangular opening about $4\frac{1}{2}$ ft. × 4 ft., with masonry flooring and a slabbed foot-way over it belonging to the Thakur of Garh (Jaipur).

The Alwar people said they had seen the previous day obstructions here to divert the stream.

It was here the Munshi said he had seen the men placing obstructions, and he pointed to some earth and thorns placed at one side of the sluice.

9. The Nehri here is about 15 to 20 ft. wide and about 5 ft. deep. The boundary between Alwar and Jaipur is marked by a vertical slab placed in the middle of the stream, projecting about 2 ft. or so above the bed and about 15 ft. up stream.

The fact of the slab being placed in the middle of the bed has the effect at times of catching any floating brushwood, and of causing a slight > shaped shoal behind it.

The Garh sluice is close by on the right bank, and the silt appears to have been cut through to admit the water to the sluice. On the west or left of the slab, the water is supposed to have a clear passage down stream; but as it is no one's business to keep it clear, it appears to be a few inches higher than the mouth of the Garh sluice—that is, higher than it should be.

10. It can be easily imagined that if any silt clearance is carelessly or purposely put on the down stream side of the sluice or behind the slab, which (as stated above) naturally catches any thorns or brushwood floating down with the water when it is low, and if there is no attempt to clear the passage on the left or west side of the boundary slab, that the effect will be, when there is only a small flow of water in the stream, that it will all flow through the Garh sluice, even if no obstruction is put across the main stream.

11. In an ordinary flood probably this deposit (whatever it got here) would be cleared away in a few minutes, but when the flow is reduced to a small amount, any small obstruction (even if put lower down stream) would be enough to cause a deeper flow down the Garh or Jaipur sluice.

12. A little lower down I saw a quantity of thorn and brushwood caught against the sides of the rocks, through which the Nehri flows. Whether this had been used for any purpose of obstruction higher up, or how it came here, it was impossible to say.

13. We went for about 3 miles down the course of the stream as far as the Alwar officials said it was necessary.

The channel here gets less in depth, being only 1½ to 2 ft. deep in some places, and less clearly defined; this is mainly owing to the slope of the country. In flood it overflows its low banks on both sides.

An irregular bank of earth has been thrown up on both sides to prevent the overflow injuring the fields.

14. This low bank appears to have been cut through in places, and small channels were visible as if to draw off water, and though no earthen bunds or obstructions were now to be seen, there were signs that they had been put by the villagers; nothing, indeed, that could withstand a flood, but sufficient to divert the water when it was not in flood. If so, this is contrary to the rule which has been laid down.

These attempts and the obstructions near the Garh Sluice are what Alwar chiefly complains off.

15. As regards the canal which the Thakur of Garh is said to have dug recently, he may have widened or extended it and cleared it, but however much he may enlarge it, so long as the sluice at its mouth is not altered, he can only get the amount of water that will pass through it.

For this reason I did not consider it necessary to go along this cut. Neither the sluice nor the channel from it is a new one.

I saw them many years ago. I think the Thakur has undoubtedly a right to a share of the water, but not to obstruct or divert it, nor to alter the size or shape of his sluices.

16. In his lands a few hundred yards lower down there was a masonry bund across the stream, with an opening, 17 ft. wide, for the Nehri main stream, and a pucca sluice about 4 ft. on the right bank, now silted up.

Also a low pucca bridge of three or five openings, partly silted up, with a 7½ ft. road-way and a well-duct along it.

Also two pucca sluices with a cut to Garh, silted up now and out of use. The Nehri has cut its way round the left side.

All these show that at one time or other, Garh must have had a good supply of water from the Nehri.

17. There were traces also above Saipur of a cut having been taken from the Nehri, and of an earthen bund at sometime having been put here, and will account for the water-courses, two of which the Superintending Engineer, Jaipur, refers to as shown in the Topographical Survey Map, 1873-74, though only one is shown in the map of the Political Agent, Alwar, 1864-68, for in heavy floods the water overflows the banks in all directions and spreads all over the country.

18. Earthen "dhols" or thin banks appear to be put across the stream in some places to serve as aqueducts to well water, though none were visible now.

19. As a general rule every village on the banks of a stream has, I think, a right to a share of the water, proportionate to the course of the stream through its lands, but no one has a right to obstruct or divert the stream at any time to the injury of others.

If permission is once given for anything there is always the danger of its being taken advantage of gradually to do more.

The temptation to divert running water when the stream is low is very great, and unless the rule is resolutely enforced complaints will continually occur. Such I think are the facts of the case.

20. I would suggest—

(1) The boundary slab near the Garh Sluice to be cut down, in the bed of the stream, to the same level as the floor of the Garh Sluice.

(2) The bed of the Garh Channel and of every cut from the Nehri that now exists, to be kept for 100 ft. at least at the same level as the bed of the sluice at its mouth.

(3) That no new cuts be made from the Nehri in either State without written permission beforehand.

(4) That no obstruction or diversion in the bed of the Nehri be allowed anywhere at any time, either to divert or obstruct the water.

(5) If well-ducts are required, troughs of sheet-iron or wood may be used, resting on earthen supports on each side—"dholes" or banks sufficient for the purpose, and no thicker—leaving a clear waterway underneath of 6 ft. at least for the free passage of the stream.

(6) These rules to be applicable to each State.

S. S. JACOB, COLONEL,
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